



Chapter 6

Protective functions of forest resources

OVERVIEW

Early forest resources assessments focused on the productive functions of forests, particularly wood supply, as this was the main issue identified by policy-makers. However, in many countries there is increasing awareness of the protective functions and environmental services provided by forests, and the importance of these for sustainable forest management. With each succeeding FRA, the environmental services provided by forests have gained increasing recognition.

As Leslie (2005) observes, “Current world demand for the products and services of forests is a mix of static or only slightly increasing demand for wood, a steady but slowly increasing demand for non-timber forest products (NTFPs) and a burgeoning, but largely unmonetized demand for environmental services”. A large proportion of these services are related to the protective role of forests. As a result, trends in forests that have a protective function were also evaluated for FRA 2010.

In the context of FRA 2010, countries were asked to report on only one variable: the area of forest with ‘protection of soil and water as the primary designated function’. The wording ‘protective’ role or function is thus, in this report, intended to denote forest areas with soil and water conservation as the main function or management objective.

The world’s forests have many protective functions, some local and some global, including protection of soils from wind and water erosion, coastal protection, avalanche control, and as air pollution filters. Quantitative and qualitative studies on the role of forests in water regulation, protection and conservation in different natural and man-made ecosystems have been published in a related Thematic Study on Forests and Water (FAO, 2008a).

KEY FINDINGS

Eight percent of the world’s forests have protection of soil and water resources as their primary objective

Around 330 million hectares of forest are designated for soil and water conservation, avalanche control, sand dune stabilization, desertification control or coastal protection. The area of forest designated for protective functions increased by 59 million hectares between 1990 and 2010, primarily because of large-scale planting in China aimed at desertification control, conservation of soil and water resources and other protective purposes.

KEY CONCLUSIONS

In view of the many protective functions of forests and their increasing importance, there is a growing imperative for countries to gather, analyse and present information on the extent and condition of forests with a protective function. All forests and woodlands, including productive forests, play a protective role to varying degrees and the protective functions could often be enhanced by an alteration of the management regime. While this might result in income foregone or greater forest management costs (for example, by avoiding harvesting on critical sites or through upgrading harvesting

practices), the value of these environmental services to human welfare, health and economies is increasingly being recognized. Environmental or ecological economics provides new tools for monetizing these services (see, for example, Landell-Mills and Porras, 2002).

FRA 2010 is the second attempt to evaluate the importance of the protective functions of forests at the global level and is based on a limited number of quantitative variables. The findings of FRA 2010 suggest that there is a trend towards increasing identification and designation of forest areas for protective purposes, which is very positive. It would seem likely that the trend for a greater proportion of the world's forests to be classified as having a protective function as the main management objective will continue and that FRA 2015 may show more than 10 percent in this category. The FRA Thematic Study on Forests and Water (FAO, 2008a) provides important recommendations in this respect.

The analysis of FRA 2010 highlights significant regional differences in the area of forests with a protective function. In some cases this is related to the reporting and definition criteria and more specifically to the fact that not all countries have a category for forests with soil and water protective function as a primary use in their national statistics. There is, therefore, a real need to harmonize and clarify the criteria for reporting under this category for FRA 2015.

FOREST AREA DESIGNATED FOR PROTECTIVE PURPOSES

Introduction

One of the most important protective function of forests is related to soil and water resources. Forests conserve water by increasing infiltration, reducing runoff velocity and surface erosion, and decreasing sedimentation (which is particularly relevant behind dams and in irrigation systems). Forests play a role in filtering water pollutants, regulating water yield and flow, moderating floods, enhancing precipitation (e.g. 'cloud forests', which capture moisture from clouds) and mitigating salinity. For FRA 2010 the variable forest area with 'protection of soil and water as the primary designated function' refers specifically to the area of forests that have been set aside for the purposes of soil and water conservation, either by legal prescription or by decision of the landowner or manager. More specifically, the variable refers to soil and water conservation, avalanche control, sand dune stabilization, desertification control and coastal protection. It does not include forests that have a protective function in terms of biodiversity conservation or those in protected areas, unless the main purpose is soil and water conservation. These forest categories are included in other parts of this report.

Status

Of 233 country reports, 205 provided information on the area of forest with protection of soil and water as the primary designated function in 2010, together accounting for 99.9 percent of the world's forest area. This indicates an improvement in overall country reporting over the last 20 years, given that in 1990 only 186 countries reported on the protective function of forests. In most regions 90 percent or more of countries reported on this variable in 2010. The main exception was the Caribbean region where fewer than half of the countries reported on this variable.

The total extent of forests which are designated for protection of soil and water was estimated in 2010 to be 330 million hectares, equivalent to 8 percent of total forest area (see Table 6.1). Asia has the highest proportion of forests with a protective function (26 percent), followed by Europe (9 percent).

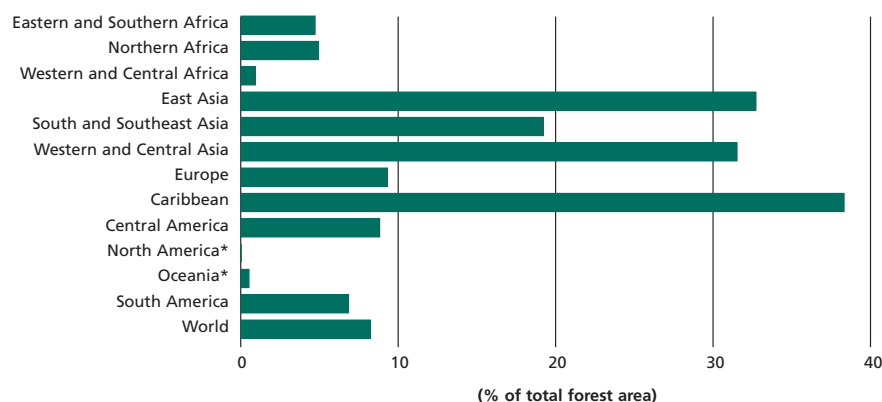
Analysis of the data at the subregional level (Table 6.1 and Figure 6.1) reveals some important differences. The highest proportion of protective forests is reported from the Caribbean region, and these forests are almost entirely located in Cuba (1.36 million

TABLE 6.1
Area of forest designated for protection of soil and water, 2010

Region/subregion	Information availability		Area of forest designated for protection of soil and water	
	Number of countries reporting	% of total forest area	1 000 ha	% of forest area
Eastern and Southern Africa	23	100.0	12 627	4.7
Northern Africa	7	99.1	3 851	4.9
Western and Central Africa	24	100.0	3 079	0.9
Total Africa	54	99.9	19 557	2.9
East Asia	5	100.0	83 225	32.7
South and Southeast Asia	17	100.0	56 501	19.2
Western and Central Asia	24	100.0	13 703	31.5
Total Asia	46	100.0	153 429	25.9
Total Europe	46	100.0	93 229	9.3
Caribbean	12	53.8	1 430	38.3
Central America	7	100.0	1 718	8.8
North America*	5	100.0	0	0
Total North and Central America	24	99.5	3 148	0.4
Total Oceania*	21	99.8	926	0.5
Total South America	14	100.0	58 879	6.8
World	205	99.9	329 168	8.2

* See text.

FIGURE 6.1
Proportion of forest area designated for protection of soil and water by subregion, 2010



* See text.

out of 1.43 million hectares). East Asia reported 33 percent protective forests, a large proportion of which (60 million out of 83 million hectares) is accounted for by China. In Western and Central Asia, Georgia, Turkmenistan and Uzbekistan are mainly responsible for the high proportion of forests with a protective function. The Russian Federation accounts for 71 million out of the 93 million hectares of protective forests reported in Europe, and Brazil makes up much of the protective forests in South America (43 million out of 59 million hectares). In Africa, almost half of the protective

forests (8.7 million hectares) are located in Mozambique. Kenya and Sudan also have important areas of protective forests, with 3.3 million hectares in Kenya and 2.4 million hectares in Sudan, out of an African total of 19.6 million hectares. Box 6.1 highlights the important role played by forests in combating desertification in arid zone countries.

BOX 6.1

Arid zone forests: preventing and combating desertification

The increasing number of communities and countries that suffer the negative impacts of land degradation and desertification is a source of huge concern to both the affected countries and the FAO. The desertification process is not merely the advance of existing deserts but rather the combined effect of localized land degradation (usually following deforestation), overexploitation of forests, trees, bush, grazing land and soil resources, and inadequate water resource management. In addition, according to the IPCC, global warming will cause a decrease in rainfall and an increase in extreme weather conditions, such as long periods of drought leading to severe water scarcity and increased desertification.

Sand encroachment, which has devastating environmental and socio-economic impacts, is another desertification challenge. It reduces arable and grazing land, and diminishes the availability of water resources, threatening the productivity of ecosystems and agriculture, as well as the food security and livelihoods of local communities.

The protective functions of forests are more important in arid zones than elsewhere. These lands are more vulnerable to desertification, due to the extremely harsh environmental and socio-economic conditions. Indeed, forests in arid zones have a significant role to play in biodiversity conservation, while providing essential ecosystem goods (such as fodder, wood, medicines and herbs, tradable goods and other NWFPs) as well as services (such as soil stabilization, water conservation, and erosion and desertification control). Their role in climate change mitigation and adaptation is also important, as the sustained provision of these ecosystems' goods and services will help adapt to hardship under a changing climate. However, despite their value, forest ecosystems in arid zones are often caught in a spiral of deforestation, fragmentation, degradation and desertification.

The sustainable management and restoration of arid zone forests is one of the main approaches promoted by FAO and its partners for preventing and combating desertification in the long term. FAO is working with its member countries, experts, research networks and partners to prepare and publish key guidelines to support member countries in their efforts to sustainably manage and rehabilitate arid zone forests. Over the last two years, FAO has facilitated country-driven and regional processes involving a wide range of experts and forestry department representatives in order to the prepare the following key publications:

- *Guidelines on good forestry and range practices in arid and semi-arid zones of the Near East* (FAO Regional Office for the Near East Working Paper – RNEO 1-09);
- *Guidelines on sustainable forest management in drylands of sub-Saharan Africa* (Arid Zone Forests and Forestry Working Paper 1, 2010);
- *Fighting against sand encroachment: lessons from Mauritania* (FAO Forestry Paper 158, 2010).

On the ground, in collaboration with its partners, FAO has implemented a number of field projects. The most recent example is the project 'Acacia Operation: Support to food security, poverty alleviation and control of soil degradation in the gum and resin producing countries'. This project involved six countries (Burkina Faso, Chad, Kenya,

Niger, Senegal and Sudan) and was funded by the Italian Government. The objective of the project was to strengthen the capacity of the six pilot countries to address food security and desertification through the improvement of agrosilvipastoral systems and the sustainable development of the gum and resin sectors. By strengthening local resources, the project focused on improving and sustaining agricultural and pastoral systems, as well as diversifying and increasing household income, thereby contributing to local socio-economic development.

A mechanized water harvesting technology was adopted (Vallerani Technology®), which permits microbasins to be dug while ploughing degraded soils. This aimed to develop Acacia-based agrosilvipastoral systems and reverse land degradation in the six pilot countries. Working with local communities, a total of 13 240 ha were successfully ploughed and planted. An intensive capacity building programme was carried out with local communities on the use and application of the mechanized water harvesting technology, nursery establishment, agricultural production, gum and resin production, tapping and quality control, including post-harvest handling. The pilot phase was successful and efforts are currently underway to secure funding for a ten-year programme, involving eight sub-Saharan countries, to address wider aspects of forest land rehabilitation, livelihoods, market development and climate change mitigation and adaptation.

A total of 86 countries state that they do not have any forest area with ‘protection’ as the primary designated function. While for certain countries this might in fact be the case (for example countries in Central and Western Asia, such as Oman, Qatar, Saudi Arabia and the Syrian Arab Republic), for other countries – most prominently those in North and Central America, and Oceania – further clarification is necessary.

A very small proportion of forests with protective functions was reported from North and Central America, and Oceania. This is due not to a lack of information in this category, but rather to the fact that these functions are generally embedded in national and local laws and guidance on sound forest management practices. While legislation, regulations and policy may provide guidance on how forest areas must address soil and water conservation, areas with protection as a specific legal designation for their primary function are rare. For example, because soil and water protection are integral considerations in the development of all forest policy and management practices, the United States of America does not report in the category of ‘primary function’. Further, the classification of protective function in Oceania is strongly affected by Australia, where the classification system does not directly relate to the designated function classes. Nonetheless, the Australian National Report states that the primary functions of many public native forests in Australia – including those used for timber production – are to protect soil, water and biodiversity.

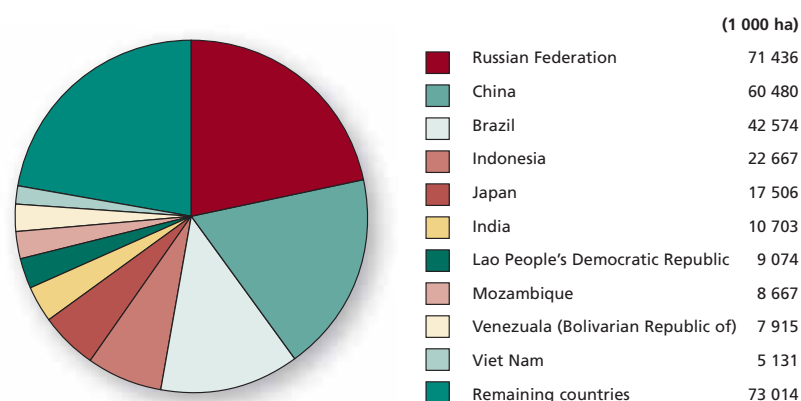
For these reasons, forest areas that are set aside for the purposes of soil and water conservation in these reporting regions are generally included under the primary designated function ‘multiple use’ in this report. Given these caveats and the fact that the combined forest area of these countries is very large, caution should be used in interpreting the data on the area of forest with ‘protection’ as the primary designated function in a global context.

Ten countries, mostly in the arid zone, report that 80 percent or more of their total forest area is designated for protective purposes (see Table 6.2). Figure 6.2 shows the ten countries with the largest area of forest designated for protective functions.

TABLE 6.2
Ten countries with the highest proportion of forest area designated for protection of soil and water, 2010

Country/area	Forest area designated for protection of soil and water (%)
Libyan Arab Jamahiriya	100
Bahrain	100
Kuwait	100
Jordan	98
Turkmenistan	97
Kenya	94
Uzbekistan	93
Azerbaijan	92
Wallis and Futuna Islands	87
Iraq	80

FIGURE 6.2
Ten countries with the largest area of forest designated for protection of soil and water, 2010



Trends

The results of the trend analysis, based on the 186 countries that provided information for all four reporting years, show an overall global increase of 59 million hectares in the area of forests with a protective function between 1990 and 2010. Table 6.3 and Figure 6.3 show how the trends vary significantly in the different regions. The positive global trend results mainly from a significant increase in forest area with a protective function in East Asia and Europe. Box 6.2 highlights the increased awareness of the role forests play in conserving water in Europe.

Detailed analysis of the country data results in a varied picture. The most significant increase in the area of forests with a protective function is reported from East Asia. This is mainly the result of large-scale planting in China aimed at desertification control, conservation of soil and water resources and other protective purposes, which more than tripled the area of protective forests between 1990 and 2010. In contrast, Mongolia reported a negative trend in this category.

In Europe the main increase was recorded in the decade between 1990 and 2000. The Russian Federation was largely responsible for this increase, where area of forest

TABLE 6.3
Trends in area of forest designated for protection of soil and water by region and subregion, 1990–2010

Region/ subregion	Information availability		Area of forest designated for protection of soil and water (1 000 ha)				Annual change (1 000 ha)		Annual change rate (%)	
	Number of countries	% of total forest area	1990	2000	2005	2010	1990– 2000	2000– 2010	1990– 2000	2000– 2010
Eastern and Southern Africa	21	80.9	14 003	13 311	12 950	12 611	-69	-70	-0.51	-0.54
Northern Africa	7	99.1	4 068	3 855	3 842	3 851	-21	0	-0.54	-0.01
Western and Central Africa	22	52.5	2 639	3 281	3 236	3 079	64	-20	2.20	-0.63
Total Africa	50	69.2	20 709	20 447	20 027	19 540	-26	-91	-0.13	-0.45
East Asia	4	90.2	24 061	38 514	58 336	65 719	1 445	2 721	4.82	5.49
South and Southeast Asia	17	100.0	55 811	57 932	59 389	56 501	212	-143	0.37	-0.25
Western and Central Asia	23	99.7	12 222	13 059	13 553	13 669	84	61	0.66	0.46
Total Asia	44	95.8	92 094	109 505	131 278	135 889	1 741	2 638	1.75	2.18
Total Europe	45	99.7	76 932	90 788	91 671	92 995	1 386	221	1.67	0.24
Caribbean	11	53.1	869	1 106	1 327	1 428	24	32	2.44	2.58
Central America	3	36.9	124	114	102	90	-1	-2	-0.90	-2.33
North America*	5	100.0	0	0	0	0	0	0	–	–
Total North and Central America	19	97.8	994	1 220	1 429	1 517	23	30	2.07	2.21
Total Oceania*	18	21.6	1 048	1 078	1 087	888	3	-19	0.28	-1.92
Total South America	10	85.1	48 656	48 661	48 542	48 549	1	-11	n.s.	-0.02
World	186	86.9	240 433	271 699	294 034	299 378	3 127	2 768	1.23	0.97

* See text.

with a protective function increased from 59 million hectares in 1990 to over 70 million hectares in 2000.

In Africa the forest area with a protective function decreased somewhat. The country information shows that the negative trend in Eastern and Southern Africa results from a decrease in forest with a protective function in the three most important countries in this category (Kenya, Mozambique and Zimbabwe).

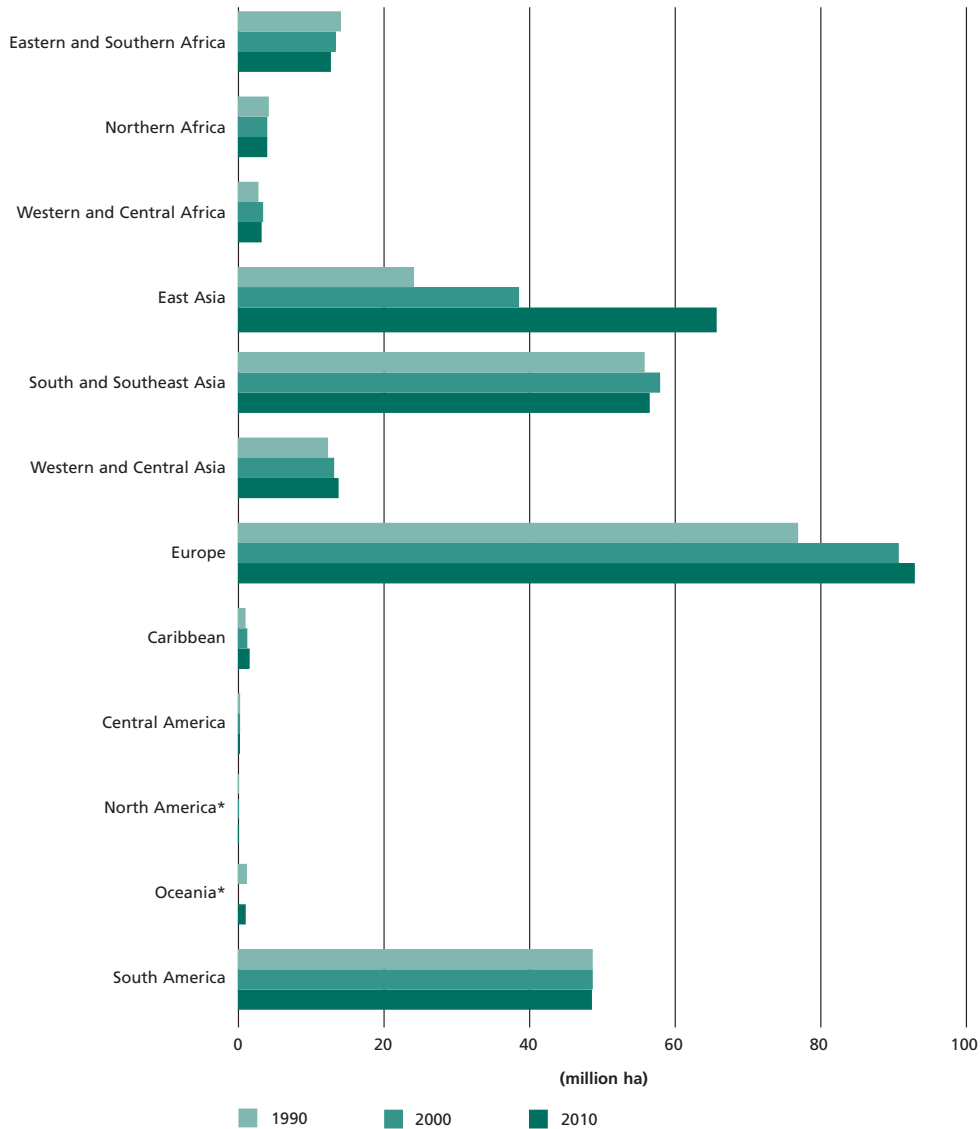
In South and Southeast Asia the forest area with a protective function increased during the decade from 1990 to 2000 and then decreased again from 2000 to 2010. The situation is quite heterogeneous in this region. A steady increase in forest cover with a protective function was reported for example by Bhutan, India, the Philippines and Thailand, but the opposite trend was registered in Bangladesh, Indonesia, Lao People's Democratic Republic, Nepal and Timor-Leste. Finally, in some countries such as Malaysia, Myanmar and Viet Nam, the forest area in this category increased between 1990 and 2000 and decreased again from 2000 to 2010.

The very low figures reported for North and Central America and Oceania are the result of differences in how soil and water protection is legislatively mandated in Canada, Mexico, the United States of America and Australia (see earlier discussion). In South America the area of forest with a protective function has remained relatively stable.

Conclusions

Around 330 million hectares of forest are designated for soil and water conservation, avalanche control, sand dune stabilization, desertification control or coastal protection.

FIGURE 6.3
Trends in area of forest designated for protection of soil and water by subregion, 1990–2010



* See text.

This area increased by 59 million hectares between 1990 and 2010 and now accounts for eight percent of the global forest area. The recent increase is primarily due to large-scale planting in China for protective purposes.

In view of the many protective functions of forests and their increasing importance, there is a growing imperative for countries to gather, analyse and present information on the extent and condition of forests with a protective function.

The analysis of data supplied for FRA 2010 highlights significant regional differences in reporting on the area of forest with a protective function and there is a clear need to harmonize and clarify the criteria for reporting under this category for FRA 2015.

BOX 6.2

Generating momentum on forests and water in Europe

Forests influence water availability and regulate surface and groundwater flows, while maintaining high water quality. Forested watersheds supply a high proportion of the water for domestic, agricultural, industrial and ecological needs in both upstream and downstream areas. The availability and quality of water in many regions of the world is increasingly threatened by overuse, misuse, pollution and the projected negative impacts of climate change. A key challenge faced by land, forest and water managers is to maximize the wide range of forest benefits without detriment to water resources and ecosystem functions, particularly in the context of adaptation to climate change, which increasingly reinforces the importance of sustainable forest management. To address this challenge, enhanced synergy is needed between the water and forest communities, through institutional mechanisms aimed at implementing programmes of actions at national and regional levels. Similarly, there is an urgent need for an even greater understanding of the interactions between forests and water, and for embedding the research findings into policy agendas.

Over the past few years, the interactions between forests and water have received increasing attention in Europe. The Warsaw Resolution 2 "Forests and Water" of Forests Europe (the former Ministerial Conference on the Protection of Forests in Europe) was a milestone in triggering this significant international momentum. The Resolution was adopted on the occasion of the Fifth Ministerial Conference held in Warsaw, Poland, from 5 to 7 November 2007. Recognizing the close interrelation between forests and water, the signatory states and the European Community committed themselves to undertaking consistent action in order to address four main areas of concern:

- sustainable management of forests in relation to water;
- coordinating policies on forests and water;
- forests, water and climate change;
- economic valuation of water-related forest services.

As part of the follow-up to the endorsement of Warsaw Resolution 2, a number of important events were organized on this topic in Europe between 2008 and 2010:

- the 26th session of the European Forestry Commission's Working Party on the Management of Mountain Watersheds, 19–22 August 2008, in Oulu, Finland, with the seminar topic "Forest, Water and Climate Change in High Altitude and High Latitude Watersheds";
- the III International Conference on Forests and Water, 14–17 September 2008, in Mragowo, Poland;
- the plenary session on forests and water held during European Forest Week, 20–24 October 2008, at FAO Headquarters, Rome, Italy;
- the international conference "Water and Forest: a Convenient Truth?", 30–31 October 2008, in Barcelona, Spain;
- the Workshop on Forests and Water, held within the work programme of Forest Europe, 12–14 May 2009, in Antalya, Turkey;
- the forests and water sessions and side event, 18–25 October 2009, at the XIII World Forestry Congress in Buenos Aires, Argentina;
- the plenary session on forests and water held during the 35th session of the European Forestry Commission, 27–30 April 2010, in Lisbon, Portugal.

Each of these events was organized by a different stakeholder group and discussed the 'forests and water' topic from a slightly different perspective. As a result, the harvest of conclusions and recommendations from these consultations is very rich. The events highlighted the gaps and misconceptions that still persist and the need to translate scientific knowledge into tools that can be used by policy-makers; the need to create national and transboundary institutions able to bring together all actors; and the need to share between countries the existing experiences related to joint forest and water management. In close collaboration with the key partner institutions that were the drivers of these events, FAO is synthesizing the recommendations resulting from this process in order to plan future actions and develop a relevant and practical international forests and water agenda.

Sources: FAO (2010b); EFC (2010)